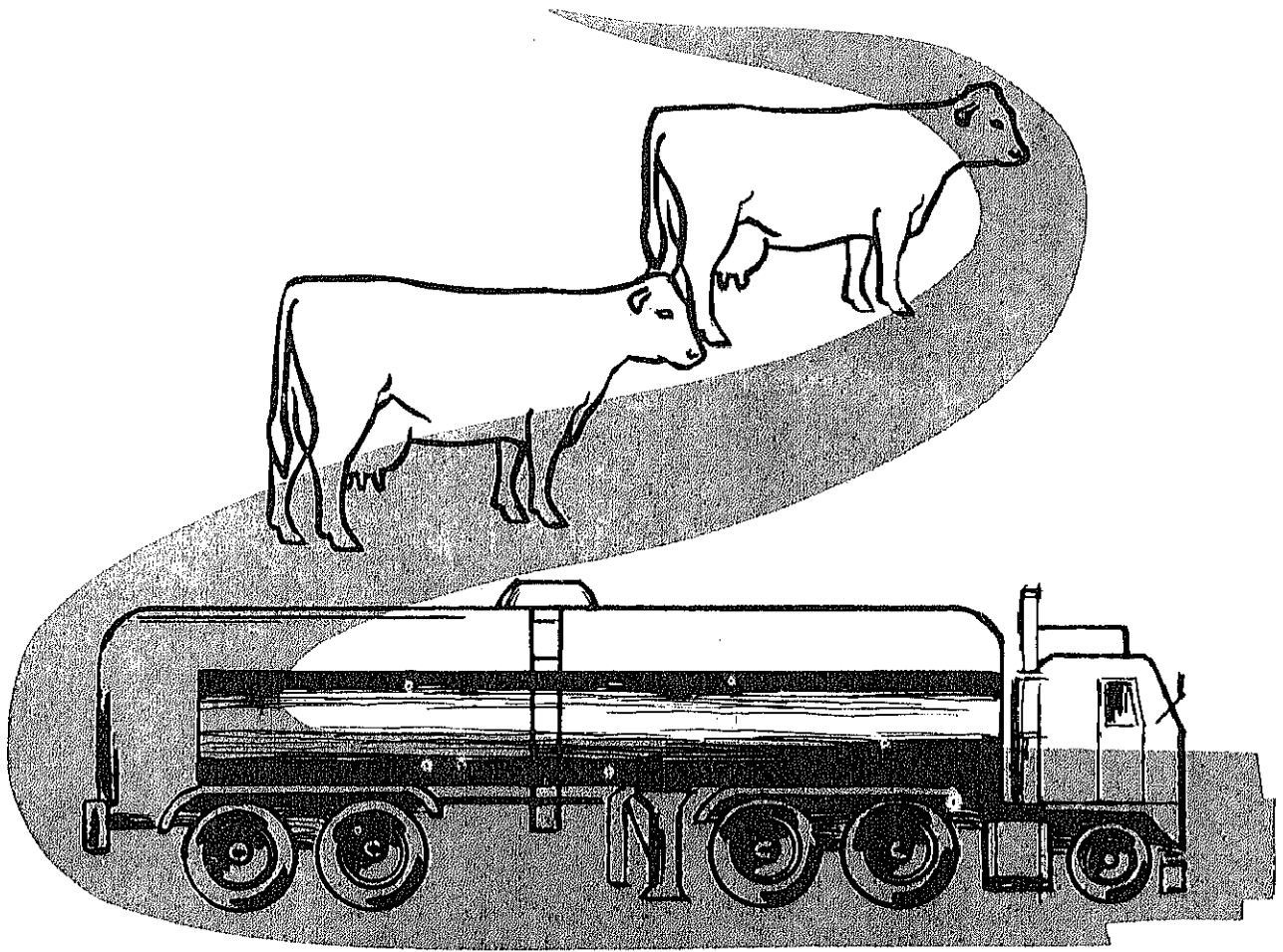


OVER-THE-ROAD COSTS OF HAULING BULK MILK



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ECONOMIC RESEARCH SERVICE
U.S. DEPARTMENT OF AGRICULTURE

ABSTRACT

This report uses synthetic cost analysis to develop total costs for a bulk milk transport carrying a 47,300-pound payload. Total trip costs are analyzed on the basis of mileage hauled, hundredweight, and hundred-weight trip mile. Results indicate cost per hundredweight trip mile is much greater for short-haul trips than for longer trips.

Keywords: Milk hauling costs, Bulk milk transport, Trucking costs.

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SUMMARY

The cost of hauling bulk milk, as derived by synthetic cost analysis for a 47,300-pound payload, is much greater for short-haul trips--under 100 miles --than for longer trips. Beyond 100 miles, average total costs tend to be relatively constant on a per trip mile basis. Average total cost per hundred-weight trip mile was 0.161 cent at 100 miles, 0.139 cent at 275 miles, 0.134 cent at 475 miles, and 0.129 cent at 650 miles. Subsistence costs for lay-over periods resulted in breaks in the total cost curve after 225, 450, and 675 miles.

Ownership costs allocated on a per trip basis, plus labor costs allocated on an hourly basis, plus operational costs distributed on a mileage basis, yielded total costs per trip. Total trip costs were analyzed on the basis of (1) hundredweight and (2) hundredweight per trip mile. Also, average total costs were broken down on the basis of estimated ownership, labor and operational costs plus subsistence costs per hundredweight per loaded one-way mile.

A step-by-step procedure is provided to assist managers and other interested persons in comparing their hauling costs with the estimates in this report. Assumptions and cost allocations can be varied to meet the needs of the individual operation.

OVER-THE-ROAD COSTS OF HAULING BULK MILK

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INTRODUCTION

Significant changes in milk hauling and management practices have occurred in the past 4 years. These include shortening time periods used to depreciate transport equipment and eliminating two-driver operations in an attempt to reduce costs for long-distance hauls. Milk haulers are also using larger capacity semitrailer tank units for both farm pickup and over-the-road hauling. In some instances, haulers now are paying drivers a flat rate or amount per trip instead of an hourly or mileage rate.

This report deals with the cost of transporting bulk milk over relatively long distances. It revises the bulk milk transportation cost section of Marketing Research Report No. 791, Costs of Transporting Bulk and Packaged Milk by Truck, Economic Research Service, U.S. Department of Agriculture, May 1967.

Generally, the methodology used in the earlier report was followed in this report. Differences in the data and in some underlying assumptions reflect changes in milk hauling practices which have occurred in the interim period (appendix tables 14 and 15).

The building-block or synthetic approach was used to develop over-the-road hauling costs. These costs are not those incurred by a specific hauling operation or milk transport company but are estimated costs associated with various mileages for a given size payload. Assumptions and costs used in this report are based upon information obtained in discussions with milk haulers, an equipment dealer, and trade association representatives, and from examination of labor contracts applicable to milk transport drivers.

DEVELOPMENT OF COSTS

Truck Utilization Time

Truck utilization time was based on the assumption that one bulk milk transport unit would be available for duty 8,760 hours per year (365 days x 24 hours) for trips of various distances. Table 1 shows the estimated

average time required per trip to perform various functions. Certain operations, such as driver checkout and vehicle inspection, loading and unloading, washing and cleaning the tank unit, and waiting time, are associated with each haul regardless of distance. Driving time, on the other hand, varies with transport speed and distance traveled.

Loading and unloading times are those required at the sending and receiving plants for interplant shipments and not shipments between an assembly point and a processing plant. Waiting time includes only the period a transport unit and driver would have to wait to begin loading or unloading at a plant.

Tank washing and cleaning time reflects the use of clean-in-place equipment at the receiving plant. Layover time for a one-driver operation is based upon safety regulations which require a driver to have 8 hours off duty after 10 hours' driving time or 15 hours on duty. ^{1/} Thus, 8 hours were added to the truck utilization time for each required layover.

Idle time is a residual figure representing the balance of time in a 24-, 48-, 72-, and 96-hour period not directly applicable to one of the specified functions. Maintenance time is included in this figure. Time required for vehicle maintenance is not directly associated with each individual trip but is based on accumulated miles. The cost of this operation is included as an operational (variable) cost which is allocated on the basis of miles traveled and not on the amount of time for each trip.

Ownership (Fixed) Costs

Ownership or fixed costs consist of depreciation (transport unit, building, and tools), insurance, interest, Federal highway use tax, State license and miscellaneous taxes, and administrative costs. The latter category includes management and office salaries, office supplies, utility expenses, legal fees, and miscellaneous office expenses (table 2).

Depreciation costs for transportation equipment were based upon information supplied by haulers. The depreciation cost per tractor unit and semitrailer tank unit was obtained by dividing the total depreciation expense charged off in 1969 for each type of equipment by the total number of units owned by the haulers in the study. This method reflects the varied depreciation methods--straight-line, declining-balance, or sum-of-the-years-digits--that can be or are used by individual haulers.

Milk haulers indicated a new tandem tractor would cost \$20,000 in 1969 and a new semitrailer tank unit, \$15,000. The tractor was estimated to have a useful life of 5 years and a salvage value of \$2,200; the semitrailer tank

^{1/} The Motor Carrier Safety Regulations, U.S. Dept. Transportation, Fed. Highway Admin., Parts 390-397, par. 395.3. Amer. Truck. Assoc., Wash., D.C., Sept. 1969.

Table 1.--Estimated average time required per trip to perform various functions, bulk milk transport unit, 47,300-pound payload, by round-trip mileage, 1969

Round-trip mileage	Checkout 1/	Loading 2/	Unloading 2/	Washing and cleaning tank 3/	Waiting time 4/	Driving time, one driver 5/	Driver layover 6/	Idle time 7/	Total time : available : truck time
					Hours				
50.....	0.42	0.81	0.83	0.47	0.76	1.11	0	19.60	24.00
100.....	.42	.81	.83	.47	.76	2.22	0	18.49	24.00
150.....	.42	.81	.83	.47	.76	3.33	0	17.38	24.00
200.....	.42	.81	.83	.47	.76	4.44	0	16.27	24.00
250.....	.42	.81	.83	.47	.76	5.55	0	15.16	24.00
300.....	.42	.81	.83	.47	.76	6.66	0	14.05	24.00
350.....	.42	.81	.83	.47	.76	7.77	0	12.94	24.00
400.....	.42	.81	.83	.47	.76	8.88	0	11.83	24.00
450.....	.42	.81	.83	.47	.76	10.00	0	10.71	24.00
500.....	.42	.81	.83	.47	.76	11.11	8	25.60	48.00
550.....	.42	.81	.83	.47	.76	12.22	8	24.49	48.00
600.....	.42	.81	.83	.47	.76	13.33	8	23.38	48.00
650.....	.42	.81	.83	.47	.76	14.44	8	22.27	48.00
700.....	.42	.81	.83	.47	.76	15.55	8	21.16	48.00
750.....	.42	.81	.83	.47	.76	16.66	8	20.05	48.00
800.....	.42	.81	.83	.47	.76	17.77	8	18.94	48.00
850.....	.42	.81	.83	.47	.76	18.88	8	17.83	48.00
900.....	.42	.81	.83	.47	.76	20.00	8	16.71	48.00
950.....	.42	.81	.83	.47	.76	21.11	16	31.60	72.00
1,000.....	.42	.81	.83	.47	.76	22.22	16	30.49	72.00
1,100.....	.42	.81	.83	.47	.76	24.44	16	28.27	72.00
1,200.....	.42	.81	.83	.47	.76	26.66	16	26.05	72.00
1,300.....	.42	.81	.83	.47	.76	28.88	16	23.83	72.00
1,400.....	.42	.81	.83	.47	.76	31.11	24	37.60	96.00
1,500.....	.42	.81	.83	.47	.76	33.33	24	35.38	96.00

1/ Time to check out plus inspect truck prior to travel.

2/ Loading and unloading assumed to be done by pumps at processor's plant or pump over plant.

3/ Time based on assumption all washing and cleaning performed by clean-in-plant equipment.

4/ Waiting time at loading and unloading points exclusive of loading, unloading, and cleaning time for tank.

5/ Based on average speed of 45 miles per hour.

6/ Department of Transportation Safety Regulations specify driving time not to exceed 10 hours without 8 consecutive off-duty hours.

7/ Maximum idle time if truck made only one trip.

unit, 8 years and \$2,300. If a straight-line depreciation schedule were followed, the 1969 depreciation charge would be \$3,560 for the tractor and \$1,575 for the semitrailer tank unit. This would be comparable to the \$4,000 shown for depreciation in table 2.

Table 2.--Annual ownership (fixed) costs, bulk milk transport unit, 47,300-pound payload, 1969

Item	Cost per year
	<u>Dollars</u>
Depreciation:	
Transport unit.....	4,000
Building and tools <u>1</u> /.....	235
Insurance <u>2</u> /.....	900
Interest <u>3</u> /.....	1,584
Federal highway use tax <u>4</u> /.....	210
State license and miscellaneous taxes <u>2</u> /..	1,450
Administrative costs <u>5</u> /.....	2,500
Total ownership costs.....	10,879

- 1/ Maintenance shop and office space.
2/ Based on hauler data.
3/ Rate of 8 percent on midlife value of transport equipment.
4/ Department of the Treasury, IRS publication 349, Vehicle Class M, May 1969.
5/ Includes management and office salaries, office supplies, utility expenses, legal fees, and miscellaneous office expenses.

Building depreciation was based on a structure with the following specifications: private industrial garage used for trucking operations, 65 feet deep by 80 feet wide, concrete block and open-web steel truss construction, estimated useful life of 33 years, and replacement construction cost in 1969 of \$69,000.

Investment in tools was assumed to be \$5,000 with replacements being made to maintain a constant tool inventory figure. These tools include lubricating equipment, hoists, and specialty items required for operating a fleet of trucks and are considered to have a useful life of 10 years. Individual mechanic's tools are not included in the tool depreciation figure.

Interest charges were based only on the midlife value of the milk transport unit and computed at the rate of 8 percent. Insurance, State licenses, and miscellaneous taxes were synthesized from information obtained from milk haulers and trade associations. Costs for management and office salaries, office supplies, utility expenses, legal fees, and miscellaneous office expenses included under the administrative cost category were based on information supplied by milk haulers.

Labor Costs

Labor was considered a separate cost category rather than a component of operating (variable) costs. This was done to account for payments to the driver for driving time and for time required during a trip when he was not actually driving the transport but was still on duty. A transport driver may receive one basic hourly rate of pay for actual driving time and another for waiting, loading and unloading, or other nondriving on-duty time. However, to facilitate allocation of costs in this report the same hourly wage rate was assumed for all on-duty time, including not only the time the operator was driving the transport but also any other time the transport was standing idle when the driver's presence was required.

Standard hours per workweek vary widely in the milk hauling industry. Haulers operate on the basis of a 5-, 6-, or 7-day workweek. Therefore, it was assumed that overtime wages would not be paid until a driver had worked 40 hours. Overtime costs are not included as it was assumed management would schedule hauling operations to avoid payment of overtime wages.

Labor costs consist of the driver's basic wage plus fringe benefit payments. These fringe payments include pension, health and welfare contributions, vacation, paid holidays, social security (employer's share only), unemployment compensation insurance, and workmen's compensation insurance (table 3).

Table 3.--Labor cost per on-duty hour, bulk milk transport unit, 1969

Item	Cost per on-duty hour
	Dollars
Average basic wage <u>1</u> /.....	3.429
Pension <u>2</u> /.....	.226
Health and welfare <u>2</u> /.....	.194
Vacation <u>3</u> /.....	.158
Paid holidays <u>3</u> /.....	.093
Social security <u>4</u> /.....	.162
Unemployment compensation insurance <u>5</u> /..	.006
Workmen's compensation insurance <u>6</u> /.....	.123
Total labor cost per on-duty hour..	4.391

1/ Based on hauler and labor contract data.

2/ Based on 40-hour workweek per driver.

3/ Based on 2 weeks' vacation, 6 paid holidays, and 49-week work year per driver.

4/ Based on 1969 Federal tax rate of 4.87 percent per first \$6600 annual earnings.

5/ Assumes employer complies with State law and receives a 90-percent reduction from 3.1-percent Federal tax rate for a 0.4-percent rate per first \$3000 earnings.

6/ Based on data furnished by National Council on Compensation Insurance.

The basic hourly wage rate was based on hauler and labor contract rates. All other labor payments were converted from a monthly or annual figure to a weekly equivalent and then divided by the standard workweek of 40 hours to obtain an hourly cost figure.

Operational (Variable) Costs

Operational costs, that is, variable costs, were developed on a mile-age basis for a bulk milk transport unit having a rated tank capacity of 5,500 gallons or a 47,300-pound payload. These costs consist of fuel, tires, maintenance (including oil, grease, and parts and labor for repairs), and miscellaneous items such as road tolls, weighing fees, and other transportation expenses directly related to the over-the-road operation of the transport unit (table 4). These figures were also converted to dollars per driving hour.

Basic data for all operational cost items were obtained in discussions with bulk milk haulers. Diesel fuel costs include the applicable Federal, State, and local taxes. Table 5 shows the average cost per tire per operational mile. Variations reported in tire wear and the number of times a carcass was recapped were due to varying road conditions and operating practices existing among haulers.

Table 4.--Operational (variable) costs for operating a bulk milk transport unit, 47,300-pound payload, 1969

Item	Cost per mile	Cost per driving hour <u>1/</u>
	Cents	Dollars
Diesel fuel.....	4.420	1.989
Tires <u>2/</u>	1.870	.842
Maintenance:		
Oil and grease.....	1.002	.451
Repairs (including parts and labor).....	5.167	2.325
Miscellaneous <u>3/</u>851	.383
Total.....	13.310	5.990

1/ Based on average speed of 45 m.p.h.

2/ From table 5.

3/ Includes road tolls, weighing fees, fines, and other transportation expenses.

Table 5.--Tire cost and wear for a bulk milk transport unit, 47,300-pound payload, 1969

Item	Units	Average
Original cost new tire (straight rib).....	Dollars	114.00
Original cost new tube <u>1</u> /.....	Dollars	9.50
New tire tread wear.....	Miles	81,000
Recap cost <u>2</u> /.....	Dollars	75.00
Recap tread wear <u>2</u> /.....	Miles	110,000
Total cost.....	Dollars	198.50
Total miles.....	Miles	191,000
Cost per tire per mile.....	Cents	0.1039
Cost per transport unit per mile (14 tires):	Cents	1.45
Cost per transport unit per mile (18 tires):	Cents	1.87

1/ Assumes new tube purchased each time new tire purchased.

2/ Based on two recaps per new tire casing.

Subsistence Costs

A subsistence allowance of \$9 a night to compensate the transport driver for overnight lodging and eating expenses was added to the variable operational costs to obtain the total trip cost where applicable. These costs amounted to an additional \$9 for round trips between 451 and 900 miles, \$18 for trips between 900 and 1300 miles, and \$27 for trips of 1400 and 1500 miles. This allocation was based on the driving limitation of 10 consecutive hours established by the Department of Transportation Safety Regulations.

RESULTS OF ANALYSIS

Average Costs

Estimated average ownership, labor, operational plus subsistence, and total costs were calculated for a 7-day week hauling operation using a 47,300-pound payload transport unit and one driver (table 6).

Ownership or fixed costs were allocated on the basis of the estimated total number of trips that might be made for specified hauling distances in a year. These costs are incurred each hour of the year whether the transport is hauling milk, being repaired, or standing idle. When allocated on an hourly basis over the total number of hours in a year ($365 \times 24 = 8,760$ hours), fixed cost per hour would be the same whether the hauler was operating on the basis of a 5-, 6-, or 7-day week.

Table 6.--Estimated average ownership, labor, operational, and subsistence costs per hundredweight trip mile, 47,300-pound payload bulk milk transport, one driver, 7-day week operation, 1969

One-way mileage 1/	:	:	Estimated	:	Estimated	:	Estimated	:	Estimated
	:	:	ownership	:	labor cost	:	operational and	:	total cost
	:	Estimated	cost per	:	per cwt.	:	subsistence	:	per cwt.
	:	trips	cwt. per	:	per one-way	:	cost per cwt.	:	per one-way
	:	per year	one-way	:	loaded	:	per one-way	:	loaded
	:	:	loaded	:	trip	:	loaded	:	trip
	:	:	trip mile	:	mile	:	trip mile	:	mile 2/
	:	Number	Cents	:	Cents	:	Cents	:	Cents
25.....	:	1245	0.074	:	0.163	:	0.056	:	0.294
50.....	:	993	.046	:	.102	:	.056	:	.205
75.....	:	825	.037	:	.082	:	.056	:	.175
100.....	:	708	.032	:	.072	:	.056	:	.161
125.....	:	620	.030	:	.066	:	.056	:	.152
150.....	:	551	.028	:	.062	:	.056	:	.146
175.....	:	496	.027	:	.059	:	.056	:	.141
200.....	:	449	.026	:	.056	:	.056	:	.138
225.....	:	412	.025	:	.055	:	.056	:	.136
250.....	:	380	.024	:	.053	:	.064	:	.142
275.....	:	354	.024	:	.052	:	.063	:	.139
300.....	:	328	.023	:	.051	:	.063	:	.137
325.....	:	310	.023	:	.051	:	.062	:	.136
350.....	:	292	.023	:	.050	:	.062	:	.134
375.....	:	274	.022	:	.049	:	.061	:	.133
400.....	:	259	.022	:	.049	:	.061	:	.132
425.....	:	248	.022	:	.048	:	.061	:	.131
450.....	:	234	.022	:	.048	:	.061	:	.130
475.....	:	223	.022	:	.048	:	.064	:	.134
500.....	:	215	.021	:	.047	:	.064	:	.132
550.....	:	197	.021	:	.047	:	.063	:	.131
600.....	:	182	.021	:	.046	:	.063	:	.130
650.....	:	172	.021	:	.046	:	.062	:	.129
700.....	:	161	.020	:	.046	:	.064	:	.130
750.....	:	150	.020	:	.045	:	.064	:	.130

1/ Assumes transport unit returns empty on backhaul. Doubling each mileage figure equals the round-trip mileage used in table 1.

2/ Sum of individual items may not equal total shown due to rounding of individual items.

Ownership costs can only be recovered when the transport is actually hauling milk. When these costs are distributed over the estimated number of trips of specified mileage that might be made in a year, they increase as the working days in the week are reduced. This method of allocating fixed costs appears to be more realistic than using an hourly basis. It accounts for variations in the normal workweek of haulers as well as for differences resulting from slack and peak seasons of milk production and shipping. Labor costs were handled on an hourly rate basis and also as a separate cost category. Operational and subsistence costs were combined into a single cost and allocated on the basis of the distance per trip.

Estimated average ownership, labor, operational plus subsistence, and total costs were also developed for 5- and 6-day week operations. In these instances, all costs except ownership were identical to those for the 7-day week. Ownership (fixed) costs were slightly higher, because they were allocated over fewer trips for the specified mileages. Labor and operational plus subsistence costs were allocated over the identical mileages used for the 7-day week analysis. Thus, these cost estimates would remain unchanged. A comparison of ownership costs is presented in table 7.

Figure 1 shows the effect of hauling distances on the average total, fixed, labor, and variable plus subsistence costs for a 7-day week bulk milk hauling operation. Since the average cost curves for a 5- and 6-day week operation would follow the same general pattern, only the 7-day period is shown.

Average Costs: 25-100 Mile One-Way Haul

Generally, as distances increase, average total costs per hundredweight trip mile decrease. This results primarily from declines in fixed and labor costs associated with increased mileage, whereas variable and subsistence costs remain relatively stable. These latter costs, however, tend to represent a greater proportion of the total average cost after 225, 450, and 675 miles when subsistence costs, paid to the transport driver for an overnight or 8-hour layover period after 10 hours of driving, are added.

The sharpest decrease in ownership or fixed and labor costs occurs for hauls ranging between 25 and 100 miles. For example, fixed and labor costs for a 25-mile haul average 0.074 and 0.163 cent per hundredweight trip mile, respectively. At 100 miles, these costs are 0.032 and 0.072 cent. Overall, these differences represent decreases per loaded trip mile of 58 percent in fixed costs and 62 percent in labor costs. These drops reflect the fairly rapid decline in fixed and labor costs as hauling distances are increased beyond the 25 mile figure. At the same time, operational or variable costs remain unchanged at 0.056 cent per loaded trip mile.

Average total costs, as a result of the foregoing changes in fixed and labor costs, fell from 0.294 cent per hundredweight trip mile at 25 miles to 0.161 cent per hundredweight trip mile at 100 miles--a 45-percent drop.

Table 7.--Comparison of ownership costs for a 5-, 6-, and 7-day week milk hauling operation, bulk milk transport unit, 47,300-pound payload, 1969

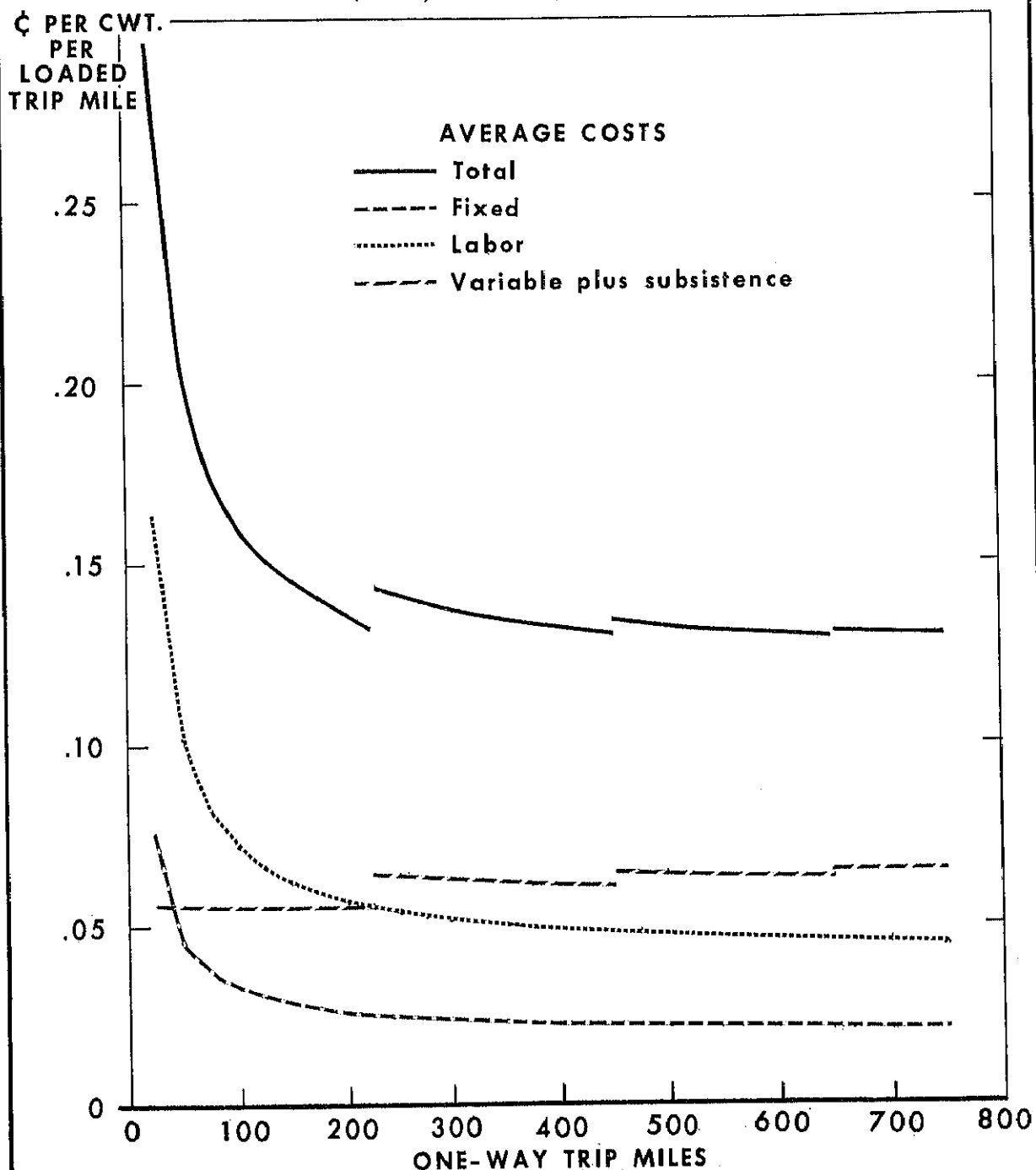
One-way mileage <u>1/</u>	: 5-day week operation		: 6-day week operation		: 7-day week operation	
	: Estimated		: Estimated		: Estimated	
	: Trips	: ownership	: Trips	: ownership	: Trips	: ownership
	: per year	: costs per	: per year	: costs per	: per year	: costs per
	<u>2/</u>	: cwt. trip	<u>2/</u>	: cwt. trip	<u>2/</u>	: cwt. trip
		: mile		: mile		: mile
	Number	Cents	Number	Cents	Number	Cents
25.....	890	0.103	1067	0.086	1245	0.074
50.....	710	.065	851	.054	993	.046
75.....	590	.052	707	.043	825	.037
100.....	506	.045	607	.038	708	.032
125.....	444	.041	532	.035	620	.030
150.....	394	.039	473	.032	551	.028
175.....	355	.037	426	.031	496	.027
200.....	321	.036	385	.030	449	.026
225.....	295	.035	354	.029	412	.025
250.....	271	.034	326	.028	380	.024
275.....	253	.033	304	.028	354	.024
300.....	235	.033	282	.027	328	.023
325.....	222	.032	266	.027	310	.023
350.....	209	.031	250	.026	292	.023
375.....	196	.031	235	.026	274	.022
400.....	185	.031	222	.026	259	.022
425.....	177	.031	213	.025	248	.022
450.....	167	.031	200	.025	234	.022
475.....	159	.030	191	.025	223	.022
500.....	154	.030	185	.025	215	.021
550.....	141	.030	169	.025	197	.021
600.....	130	.029	156	.025	182	.021
650.....	123	.029	147	.024	172	.021
700.....	115	.029	138	.024	161	.020
750.....	107	.029	128	.024	150	.020

1/ Assumes transport unit returns empty on backhaul. Doubling each mileage figure equals the round-trip mileage used in table 1.

2/ Based on Department of Transportation Safety Regulations which require 8 hours off-duty time after 15 hours' on-duty time or 10 hours' driving time.

ESTIMATED AVERAGE COSTS OF TRANSPORTING BULK MILK, 47,300-POUND PAYLOAD, ONE DRIVER, 1969

(7-Day Week Operation)



BREAKS RESULT FROM SUBSISTENCE PAID TO DRIVER FOR REQUIRED LAYOVER.

U.S. DEPARTMENT OF AGRICULTURE

NEG, ERS 7956-70 (10) ECONOMIC RESEARCH SERVICE

Figure 1

Average Costs: 100-400 Mile One-Way Haul

Fixed and labor costs decline at a much smaller rate for hauls exceeding 100 miles than for distances between 25 and 100 miles. On hauling distances between 100 and 400 miles, both fixed and labor costs decline slowly, while operational or variable costs remain constant at 0.056 cent per loaded one-way mile for all trip distances up to and including 225 miles. At this point, they increase to 0.064 cent, due to the addition of subsistence expenses, and then decline to 0.061 cent at the 400-mile hauling distance. In this instance, average total costs drop from 0.161 cent per hundredweight per one-way loaded trip mile for 100-mile hauling distances to 0.132 cent at 400 miles--an 18-percent drop.

Average Costs: 400-750 Mile One-Way Haul

On hauling distances between 400 and 750 miles, fixed and labor costs continue to average lower for each additional hauling mile. On the other hand, additional subsistence costs increase the total variable and subsistence cost from 0.061 to 0.064 cent per hundredweight per loaded one-way trip mile.

Despite increased variable and subsistence costs, average total costs declined from 0.132 to 0.130 cent per hundredweight loaded trip mile--a 1.5-percent decrease.

Total Costs

Estimated total cost figures were computed for a 5-, 6-, and 7-day week operation. As shown in table 8, these total costs were (1) per hundredweight and (2) per hundredweight mile.

The hundredweight costs per mile for the distances shown were used to develop a series of total cost functions for the transportation of bulk milk on a 7-day week basis (table 9). Cost functions for 5- and 6-day week operations follow patterns similar to that for 7 days. These equations relate hundredweight per mile costs to one-way mileage and assume no backhaul cargo was carried.

Figure 2 shows the effects of hauling distance on total costs of milk transport. Breaks occurring in the total cost curve after 225, 450, and 675 miles result from the subsistence paid to the transport operator for an overnight or 8-hour layover after 10 hours' driving time.

Table 8.--Estimated costs of transporting bulk milk over various distances by bulk milk transport,
47,300-pound payload, one driver, 5-, 6-, and 7-day week operations, 1969

One-way mileage 1/	Trips per year 2/		Cost per hundredweight		Cost per hundredweight mile	
	5-day : week	6-day : week	7-day : week	5-day : week	6-day : week	7-day : week
	Number		Cents		Cents	
25.....	890	1067	1245	8.076	7.647	7.339
50.....	710	851	993	11.168	10.632	10.245
75.....	590	707	825	14.265	13.620	13.154
100.....	506	607	708	17.349	16.593	16.052
125.....	444	532	620	20.422	19.565	18.951
150.....	394	473	551	23.516	22.541	21.853
175.....	355	426	496	26.595	25.515	24.753
200.....	321	385	449	29.719	28.528	27.676
225.....	295	354	412	32.797	31.497	30.583
250.....	271	326	380	37.823	36.396	35.393
275.....	253	304	354	40.869	39.344	38.275
300.....	235	282	328	44.003	42.371	41.228
325.....	222	266	310	47.013	45.299	44.072
350.....	209	250	292	50.095	48.290	46.967
375.....	196	235	274	53.262	51.315	49.922
400.....	185	222	259	56.397	54.325	52.845
425.....	177	213	248	59.397	57.201	55.677
450.....	167	200	234	62.622	60.349	58.678
475.....	159	191	223	67.655	65.231	63.503
500.....	154	185	215	70.562	68.059	66.324
550.....	141	169	197	76.814	74.111	72.177
600.....	130	156	182	83.069	80.120	78.014
650.....	123	147	172	88.950	85.898	83.623
700.....	115	138	161	97.038	93.704	91.324
750.....	107	128	150	103.408	99.882	97.246

1/ Assumes transport unit returns empty on backhaul. Doubling each mileage figure equals the round-trip mileage used in table 1.

2/ Based on Department of Transportation Safety Regulations requiring 8 hours' off-duty time after 15 hours' on duty or 10 hours' driving time.

Table 9.--Bulk milk transportation cost functions, tractor and semitrailer tank transport units, 47,300-pound payload, one driver, 7-day week operation, 1969

One-way mileage interval	:	Applicable equations
25-225	:	$Y = 4.434 + .058X$
226-450	:	$Y = 6.293 + .058X$
451-675	:	$Y = 8.878 + .058X$
676 plus	:	$Y = 8.444 + .059X$

Y = Cents per cwt.

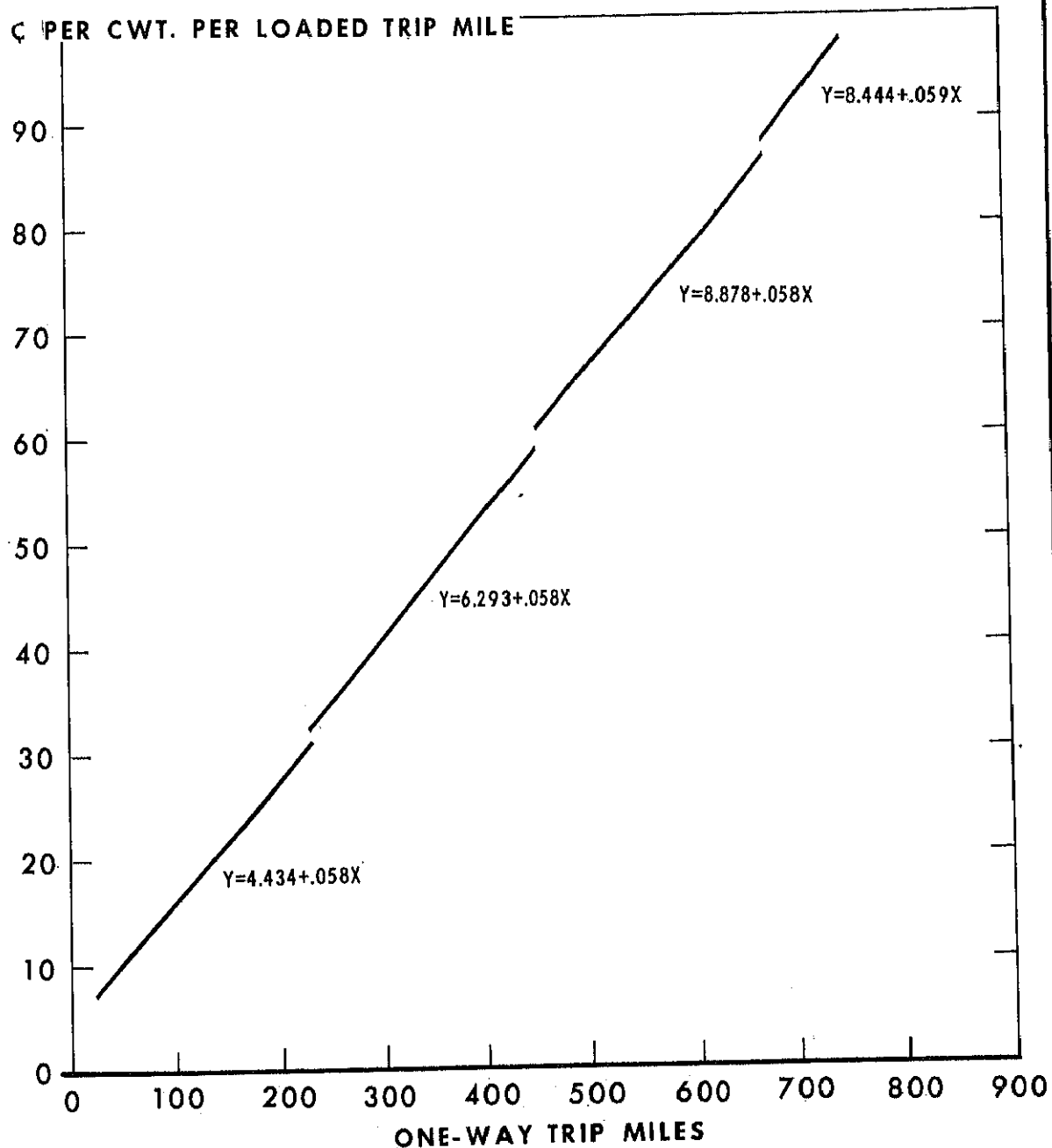
X = One-way trip mileage.

USE OF DATA

The preceding estimates can be used by milk haulers and other interested parties to compare their own operating data. These cost data are synthesized for a few specified conditions and assumptions; no effort has been made to cover the wide range of possible conditions under which haulers operate. By following the step-by-step procedures shown in tables 10-13 and making entries in the blank columns provided, a hauler can vary the assumptions and input specifications to coincide with his operations and make meaningful comparisons. This procedure also can be used to compare the effects on costs of various changes in transport equipment and hauling practices.

TOTAL UNIT COST OF TRANSPORTING BULK MILK, 47,300- POUND PAYLOAD, ONE DRIVER, 1969

(7-Day Week Operation)



BREAKS RESULT FROM SUBSISTENCE PAID TO DRIVER FOR REQUIRED LAYOVER.

U.S. DEPARTMENT OF AGRICULTURE

NEG. ERS 7957-70 (10) ECONOMIC RESEARCH SERVICE

Figure 2

Table 10.--Calculation of annual ownership (fixed costs) per bulk milk transport unit, 1969

Item and computation procedure	Annual average cost	
	1969 study	Hauler or other user data
	Dollars	
<u>Depreciation:</u>		
<u>Tractor</u>		
Total 1969 tractor depreciation ÷ No. of tractors in fleet = Depreciation per unit	2,500	
<u>Semitrailer tank unit</u>		
Total 1969 semitrailer depreciation ÷ No. of semitrailers in fleet = Depreciation per unit	1,500	
<u>Buildings</u> (garage and garage office only)		
Cost, new (1966): \$69,600		
Depreciation period, 33 years		
Annual depreciation: $\frac{\$69,600}{33} = \$2,109$		
Annual depreciation ÷ No. of units in fleet = Depreciation per unit	190	
<u>Tools</u> (excluding mechanic's tools)		
Cost, new: \$5,000		
Depreciation period, 10 years		
Annual depreciation = $\frac{\$5,000}{10} = \500		
Annual depreciation ÷ No. of units in fleet = Depreciation per unit	45	
<u>Insurance: 1/</u>		
Garage building X.XX		
Liability and property damage X.XX		
Cargo X.XX		
Accident X.XX		
Total insurance cost X.XX		
Annual insurance cost ÷ No. of units in fleet = Insurance cost per unit	900	

Continued--

Table 10.--Calculation of annual ownership (fixed costs) per bulk milk transport unit, 1969--Continued

Item and computation procedure	Annual average cost	
	1969 study	Hauler or other user data
	Dollars	
Interest:		
Midlife value of transport		
Unit = $\frac{\text{Cost new} + \text{salvage value}}{2} \times \text{interest rate}$		
$\frac{\$35,000 + \$4,600}{2} \times 8\%$	1,584	
Federal highway use tax:		
Vehicle Class M. (full-year operation) (IRS publication #349, May 1969)	210	
State licenses and miscellaneous taxes: 1/		
State vehicle license fee X.XX		
State weight taxes (if applicable) X.XX		
Other miscellaneous State taxes X.XX		
Total State and misc. taxes X.XX		
Total State and misc. taxes + No. of units in fleet = State and misc. tax cost per unit	1,450	
Administrative expenses: 1/		
Management salaries X.XX		
Office salaries X.XX		
Office supplies X.XX		
Utility fees X.XX		
Legal fees X.XX		
Other misc. office expenses X.XX		
Total administrative expenses X.XX		
Total administrative expense + No. of units in fleet = Administrative cost per unit	2,500	
Total annual ownership (fixed) costs per transport unit	10,879	

1/ Certain costs were reported in aggregate by reporting firms. Differences in accounting procedures made it impractical to break down some costs.

Table 11.--Calculation of labor costs for bulk milk transport unit, one driver, 1969

Item and computation procedure	Cost per hour	
	1969 study	Hauler or other user data
	Dollars	
Cost per driving hour:		
Basic hourly wage (study average)	3.429	
<u>Pension</u>		
Cost per week ÷ standard work hours = Cost per hour		
Study average \$9.049 ÷ 40 =	.226	
<u>Health and welfare</u>		
Cost per week ÷ standard work hours = Cost per hour		
Study average \$7.776 ÷ 40 =	.194	
<u>Vacation</u>		
Cost per week ÷ standard work hours = Cost per hour		
Study average \$6.320 ÷ 40 =	.158	
<u>Paid holidays</u>		
Cost per week ÷ standard work hours = Cost per hour		
Study average \$3.700 ÷ 40 =	.093	
<u>Social Security</u> (4.9% of 1st \$6,600 annual earnings)		
Cost per week ÷ standard work hours = Cost per hour		
Study average \$6.465 ÷ 40 =	.162	
<u>Unemployment compensation insurance</u> (0.4% of 1st \$3000 earnings)		
Cost per week ÷ standard work hours = Cost per hour		
Study average \$0.245 ÷ 40 =	.006	
<u>Workmen's compensation insurance</u> (Average 1969 rate of \$3.576 per \$100 payroll):		
Cost per week ÷ standard work hours = Cost per hour		
Study average \$4.904 ÷ 40 =	.123	
Total labor cost per driving hour	4.391	

Continued--

Table 11.--Calculation of labor costs for bulk milk transport unit, one driver, 1969--Continued

Item and computation procedure	Cost per hour	
	1969 study	Hauler or other user data
	Dollars	
Cost per nondriving hour:		
Basic hourly wage (study average)	3.429	
Pension		
Cost per week + standard work hours		
Study average \$9.049 ÷ 40 =	.226	
Health and welfare		
Cost per week + standard work hours		
Study average \$7.776 ÷ 40 =	.194	
Vacation		
Cost per week + standard work hours		
Study average \$6.320 ÷ 40 =	.158	
Paid holidays		
Cost per week + standard work hours		
Study average \$3.700 ÷ 40 =	.093	
Social Security (4.9% of 1st annual earnings)		
Cost per week + standard work hours		
Study average \$6.465 ÷ 40 =	.162	
Unemployment compensation insurance		
(0.4% of 1st \$3000 earnings)		
Cost per week + standard work hours = Cost per hour		
Study average \$0.245 ÷ 40 =	.006	
Workmen's compensation insurance		
(Average 1969 rate of \$3.576 per \$100 payroll):		
Cost per week + standard work hours		
Study average \$4.904 ÷ 40 =	.123	
Total labor cost nondriving hour	4.391	

Table 12.--Calculation of operational (variable) costs per bulk milk transport unit, 1969

Item and computation procedure	Cost per mile	
	1969 study	Hauler or other user data
	Cents	
<u>Fuel:</u>		
Diesel oil-cost per gallon + average m.p.g.		
Study average \$0.24 + 5.43 =	4.420	
<u>Tires:</u>		
New tire cost \$114.000		
New tube cost 9.500		
Recap cost (2 times) 75.000		
Total tire cost \$198.500		
Treadwear new tire 81,000 mi.		
Treadwear recap (2 times) 110,000 mi.		
Total treadwear 191,000 mi.		
Cost per mile = No. wheels X (New tire cost + recap cost + tube cost) + (Treadwear new tire + treadwear recap)		
Study average 18 X \$198.500 + 191,000 =	1.870	
<u>Maintenance and repairs (transport) 1/</u>		
<u>Lubrication:</u>		
Oil X.XX		
Grease X.XX		
Total oil and grease X.XX		
Total oil and grease expense + total annual mileage = Cost per mile		
Study average \$3.702 + 369,475 miles =	1.002	
<u>Repairs:</u>		
Parts X.XX		
Labor X.XX		
Outside repairs X.XX		
Total repair expense X.XX		
Total repair expense + total annual mileage = Cost per mile		
Study average \$37,251 + 720,943 =	5.167	

Continued--

Table 12.--Calculation of operational (variable) costs per bulk milk transport unit, 1969--Continued.

Item and computation procedure	Cost per mile	
	1969 study	Hauler or other user data
	Cents	
Miscellaneous expenses 1/		
Road tolls X.XX		
Weigh fees X.XX		
Fines X.XX		
All other over-the-road costs		
directly related to transport unit X.XX		
Total miscellaneous expenses X.XX		
Total misc. expenses ÷ total annual mileage =		
Cost per mile		
Study average \$10,615 ÷		
1,247,356 miles =	.851	
Total operational (variable) costs per mile	13.310	

1/ Certain expense data were not available from all reporting firms. Costs reported were adjusted to a comparable per unit basis.

Table 13.--Sample cost calculation for 400-mile round-trip haul, 5,500-gallon (47,300-pound) payload, bulk milk transport unit, 1969

Item and computation procedure	1969	Hauler or other user data
A. Round-trip mileage distance	400 miles	
B. Possible number of round-trips per year (7-day week)	449 trips	
C. Driving time per trip	8.88 hours	
D. Nondriving time per trip	3.29 hours	
E. Total on-duty time per trip	12.17 hours	
F. <u>Estimated ownership cost per trip</u>		
Total annual ownership costs (table 10)		
÷ B = Ownership per trip		
Study figures \$10,879 ÷ 449 =	\$24.229	
G. <u>Estimated labor cost per trip</u>		
Driving hours X labor cost per driving hour (table 11) =	X.XX	
Nondriving hours X labor cost per nondriving hour (table 11) =	X.XX	
Total labor cost per trip	X.XX	
<u>Study figures:</u>		
Driving time 8.88 X \$4.391 = \$38.992		
Nondriving time 3.29 X 4.391 = 14.446		
Total labor cost =	\$53.438	
H. <u>Estimated operational (variable) cost per trip</u>		
Cost per mile (table 12) X round trip mileage = Operational (variable) cost per trip		
Study figure \$0.1331 X 400 =	\$53.240	

Continued--

Table 13.--Sample cost calculation for 400-mile round-trip haul, 5,500-gallon (47,300-pound) payload, bulk milk transport unit, 1969--Continued

Item and computation procedure	1969	Hauler or other user data
I. <u>Total cost per trip</u>		
Item F + G + H = Total trip cost		
Study figure \$24.229 +		
53.438 + 53.240 =	\$130.907	
J. <u>Cost per loaded trip mile</u>		
Item I + $\frac{1}{2}$ A = Cost per loaded mile		
Study figure \$130.907 +		
$\frac{400}{2}$ =	\$0.6545	
K. <u>Cost per hundredweight trip mile</u>		
Item J + number of cwt. in payload =		
Cost per cwt. trip mile		
Study figure \$0.6545 +		
473 =	\$0.00138	

APPENDIX TABLES

Table 14.--Comparison of significant differences between 1966 and 1969 studies

Item	1966	1969
<u>Transport equipment</u>		
Tractor unit.....	Both straight and sleeper cabs	Straight cab only
Semitrailer tank unit.....	3,500 gallon (30,000-pound payload) 5,700 gallon (49,000-pound payload)	5,500 gallon (47,300-pound payload) only
Reload station transfer costs..	Included	Excluded
Road speed.....	40 miles per hour	45 miles per hour
Tank washing and cleaning time.	Not included as separate item	Included as separate item
Waiting time.....	Not included as separate item	Included as separate item
Driver operation.....	One- and two-driver	One-driver only
Delivery time.....	Assumed to be between 5 a.m. and 1 p.m.	Not limited to 5 a.m. and 1 p.m.
Equipment depreciation.....	7 years for tractor 10 years for trailer unit	5 years for tractor 8 years for trailer unit
Interest charge.....	6 percent on midlife of equipment	8 percent on mid-life of equipment
<u>Tire wear</u>		
New tread mileage.....	75,000 miles	81,000 miles
Recap tread mileage (2 recaps)..	85,000 miles	110,000 miles
<u>Salvage value</u>		
Tractor unit.....	\$1,000	\$2,200
Semitrailer unit.....	\$1,000	\$2,400
Truck utilization.....	Based on total time available	Based on number of trips attainable per year

Table 15.--Comparison of selected costs for 1966 and 1969 studies

Item	1966	1969
<u>Annual ownership (fixed) costs:</u>		
Depreciation:		
Transport.....	2,980	4,000
Building and tools.....	232	235
Insurance.....	1,177	900
Interest.....	744	1,584
Federal highway use tax.....	180	210
State license and miscellaneous taxes.....	609	1,450
Administrative costs.....	1,622	2,500
Total annual fixed cost.....	7,544	10,879
<u>Labor costs per hour: 1/</u>		
Basic wage 2/.....	4.117	3.429
Pension 3/.....	.320	.226
Health and welfare.....	---	.194
Vacation.....	---	.158
Paid holidays.....	---	.093
Social security.....	.142	.162
Unemployment compensation.....	.055	.006
Workmen's compensation.....	.010	.123
Total labor compensation.....	4.644	4.391

Continued--

Table 15.--Comparison of selected costs for 1966 and 1969 studies--Continued

Item	1966	1969
	<u>Cents</u>	
<u>Operational (variable) costs per mile:</u>		
Fuel, diesel.....	4.02	4.42
Tires.....	2.20	1.87
Maintenance:		
Oil and grease.....	.76	1.00
Repairs (parts and labor)....	2.43	5.17
Miscellaneous.....	.93	.85
Total operational (variable) costs per mile.....	10.34	13.31

1/ 1966 study average labor costs per mile multiplied by 40 m.p.h. to obtain comparable 1969 cost per on-duty or driving hour.

2/ 1966 data includes welfare payments.

3/ 1966 basic wage rate includes payment for vacation and paid holidays. Also, contract data used in 1966 were for general freight labor contracts and these rates were not directly applicable to bulk milk hauling. 1969 basic wage rates based on union contracts directly applicable to bulk milk hauling plus individual hauler data.

